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Guidance for Transportation Technologies: Fuel Choice for Fuel Cell Vehicles Phase III - Stakeholder Risk Analysis

Kick-Off Presentation

Presentation to DOE

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Although many studies have been devoted to fuel choices for FCVs, none have clearly addressed the risk issue head-on.

- What is the “best” fuel choice for fuel cell vehicles?
  - Impact on resources, global climate (“greenhouse effect”), consumer cost
- What are the risks?
  - Safety, financial, environmental, and technical
  - What if technologies fail or become obsolete (“Betamax” scenario)
- Who is most at risk?
  - Who is motivated to accept the risks?
  - Stakeholders and their roles could change
  - e.g. financial risk of car makers is higher for on-board gasoline reformer FCVs, but very low for energy companies and fuel distributors

An authoritative study with a broad basis of support is needed that can serve as a platform for discussion by the stakeholders.

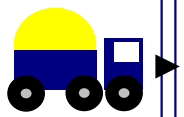
Direct-hydrogen and reformer-based systems have very different sets of risks, but a choice must be made.

	On-Board Reformer	Direct Hydrogen
Fuel	***High efficiency:*** around 80% for gasoline	***Moderate efficiency:*** from 70% for central production to 60% for decentralized production with compression to 5,000 psia
	Infrastructure exists: for gasoline	***New infrastructure required***
	Moderate fuel cost: around $7/GJ for gasoline	***High fuel cost:*** more than $20/GJ for compressed hydrogen
Fuel Cell Power Unit	***Large stack***: reformate quality limits stack performance	***Compact stack***
	Complex: primarily because of fuel processing system	***Simple***: pressurized hydrogen ***Complex***: metal hydrides
	Heavy: due to larger stack and fuel processor	***Lighter:*** no fuel processor and compact light stack
	Good efficiency	***Excellent efficiency***
Vehicle	***Established safety standards***	***Safety standards yet to be completed***
	Compact storage: high energy density	***Bulky storage:*** low energy density
	Requires ***sizable battery*** needed to bridge cold-start	Requires ***small battery*** for start-up & transients

In this phase of work, we will address the risk issue by building on our Phase II work and obtaining stakeholder input.

- In Phase II, ADL analyzed the well-to-wheels energy use, GHG emissions, safety, and vehicle ownership cost of various fuel choices for fuel cell vehicles
  - Compared to conventional and advanced (hybrids) ICE vehicles
  - Focused on direct hydrogen fuel cell vehicles and hydrogen fuel chains
- In this Phase, we plan to analyze the risks of each fuel choice based on extensive analysis and stakeholder input
  - Expand Phase II well-to-wheel analysis for additional fuel chains
  - Analyze impact on current fuel production and distribution infrastructure
  - Characterize safety, financial, environmental, and technical risks of each stakeholder (car makers, technology developers, energy companies, fuel distributors) for each fuel choice
  - Identify how risks might be shared and minimized

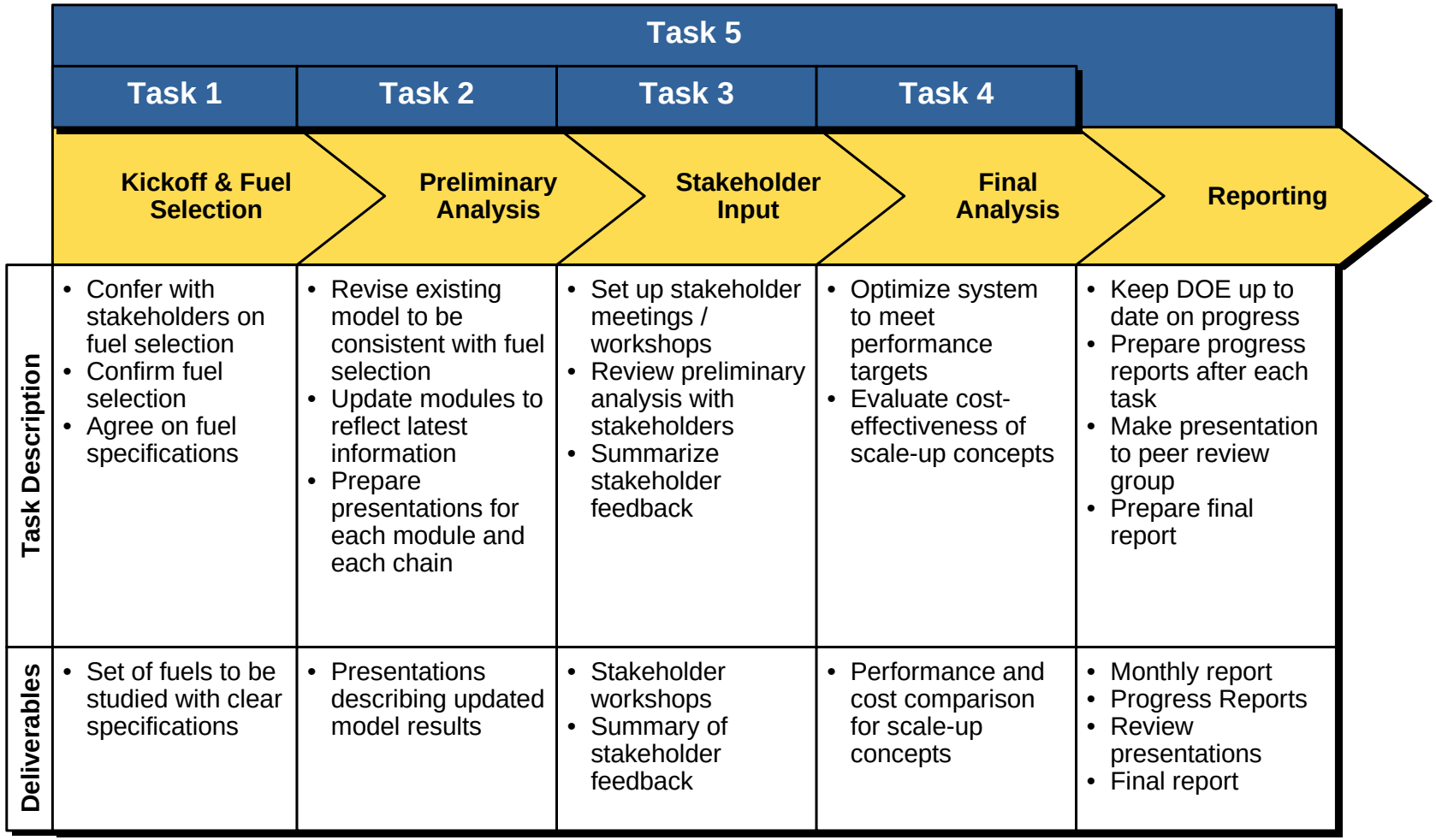
We need the input of all key stakeholders to help them converge on a set of fuel choice options to pursue.

Fuel Companies (examples)	Fuel Chain Module					
	 Resource Production	 Resource Transport	 Fuel Production	 Fuel Distribution	 Fuel Marketing	 Vehicle
Major Oil companies (BP, Conoco, ExonMobil)	●	●	●	●	●	
Methanol Companies (Methanex, BP)			●	●		
Natural Gas Companies (Southern California Gas,)		●	NA	●	●	○
Hydrogen Companies (Shell Hydrogen, Air Liquide, [illegible])	●	●	●	●	●	○
Ethanol Producers (BP, Conoco, ExonMobil)	○	●	●			
Fuel Cell Companies (Excellsis, IFC, Nuvera)						●
Vehicle OEMs (GM, Ford, Chrysler)						●

Preliminary

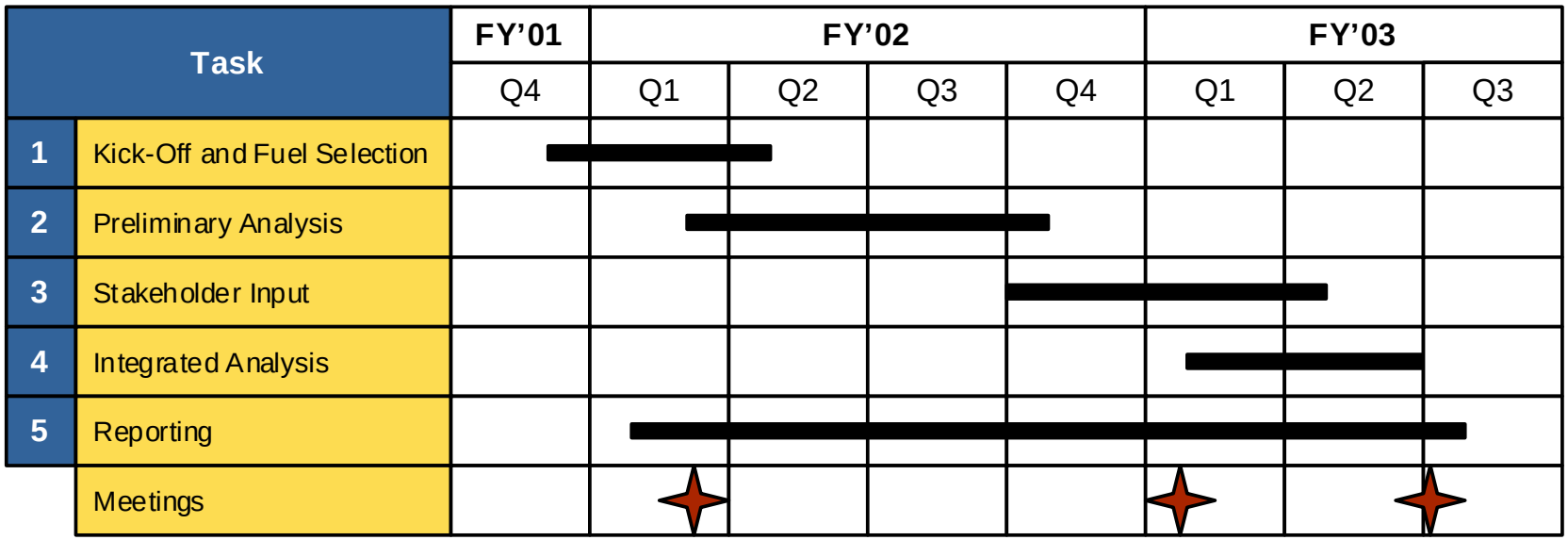
We anticipate holding workshops to consolidate this input in about a year from now.

We have organized our work into five tasks, culminating in an authoritative final report.

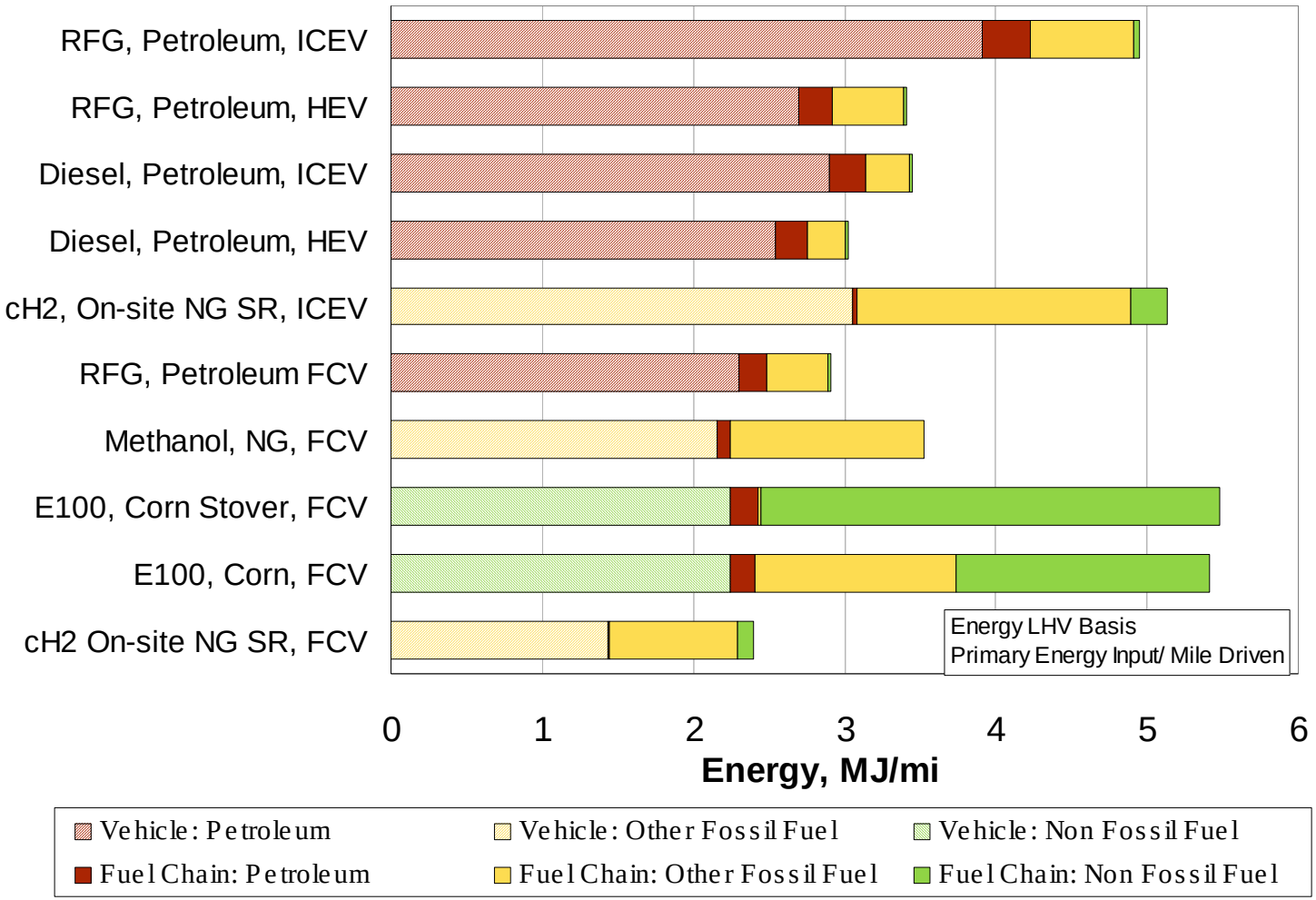


	Kickoff & Fuel Selection	Preliminary Analysis	Stakeholder Input	Final Analysis	Reporting
Task Description	• Confer with stakeholders on fuel selection • Confirm fuel selection • Agree on fuel specifications	• Revise existing model to be consistent with fuel selection • Update modules to reflect latest information • Prepare presentations for each module and each chain	• Set up stakeholder meetings / workshops • Review preliminary analysis with stakeholders • Summarize stakeholder feedback	• Optimize system to meet performance targets • Evaluate cost-effectiveness of scale-up concepts	• Keep DOE up to date on progress • Prepare progress reports after each task • Make presentation to peer review group • Prepare final report
Deliverables	• Set of fuels to be studied with clear specifications	• Presentations describing updated model results	• Stakeholder workshops • Summary of stakeholder feedback	• Performance and cost comparison for scale-up concepts	• Monthly report • Progress Reports • Review presentations • Final report

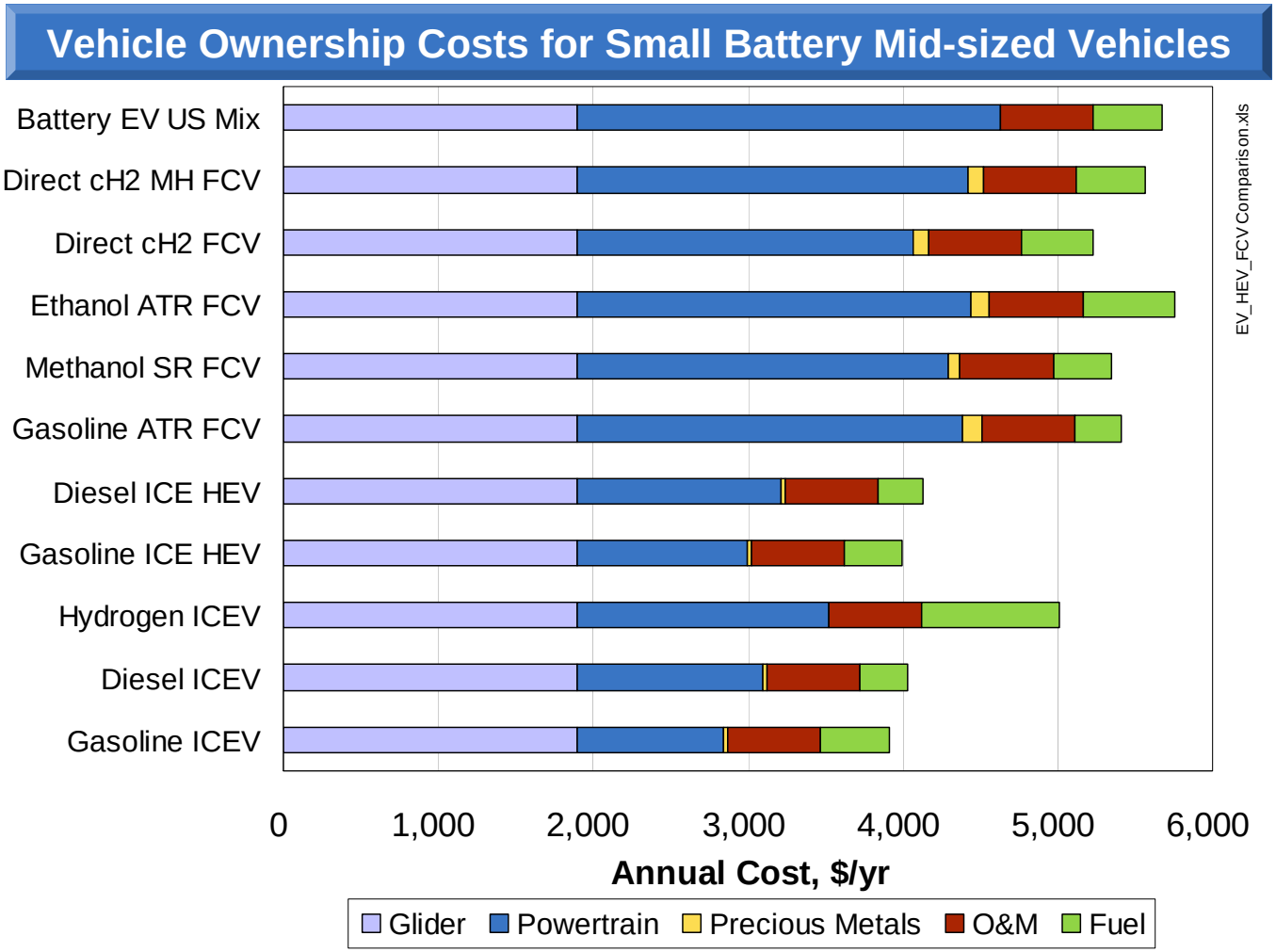
We plan to complete this project in twenty months from our September 1st start date.



Phase II results showed well-to-wheel energy use to be the lowest for direct hydrogen FCVs utilizing hydrogen from natural gas.



However, ownership costs for all fuel cell vehicle options will be significantly higher than conventional and advanced ICE vehicles.



Note: All vehicles are based on the same midsized vehicle platform with 350 mile range except the Battery EV which has only a 120 mile range.